

HOT KNIFE CUTTERTechnical Field

5 This invention pertains to methods and apparatus for cutting tire ply stock and the like.

Background Art

10 Different apparatus and methods have been utilized in order to provide cut-to-length sections of ply stock used for building tires. In U.S. Patent Nos. 3,429,490 and 3,641,855, apparatuses which utilize plunging knives are disclosed. In these apparatuses, a pair of knives is used to transpierce the ply stock at the center of the ply. Then each knife is moved to an opposite lateral edge of the ply stock. The cuts are made from the center outward in order to avoid crushing the lateral edges of the ply stock. A disadvantage of these apparatuses is that the two knives must cut between the same pair of adjacent cords.

15 In U.S. Patent No. 3,789,712 a single knife blade is used. The blade is moved into a first edge of the ply which is lifted from the conveyor up against a stock support and held there by the oblique cutting edge while the knife blade makes its cutting stroke. This is an attempt to cut the ply without plunging the knife or using two cutters. A disadvantage of this type of cutter is that the lateral edge of the ply stock is subjected to an inwardly directed cut and damage to the edge may occur.

20 U.S. Patent No. 4,156,378 discloses an apparatus which uses a circular rotatable disc cutter to engage a hard surface of an anvil and then roll on the surface to part the ply stock between a pair of cords. Again, the lateral edge is subjected to an inwardly directed cut.

25 The present invention provides a method and apparatus for severing ply stock between adjacent cords without the use of two separate knife blades in a way that does not damage lateral edges of the ply stock.

Disclosure of Invention

30 In accordance with the practice of the present invention, there is provided a new and improved method and apparatus for severing a belt package and the like to a predetermined length at a desired bias angle which employs a heated knife blade to facilitate clean cutting of the belt package between adjacent cords.

35 According to one aspect of the invention there is provided a method for cutting an associated ply stock along a cut line using a cutting apparatus comprising a knife assembly, means for moving knife assembly normally toward and away from ply stock, and means for traversing knife assembly between a first lateral edge and a second lateral edge of ply stock, knife assembly including a blade having a cutting portion including a leading point, a leading edge and a trailing edge, trailing edge

having an associated length, ply stock having spaced first and second lateral edges, the method characterized by the steps of:

a. moving knife assembly toward ply stock to insert the leading point of knife blade into ply stock at an insertion point spaced a distance from first lateral edge wherein distance is less than or equal to length in order to back-cut ply stock from insertion point to first lateral edge with trailing edge of blade; and,

b. traversing knife assembly across ply stock toward second lateral edge in order to cut ply stock from insertion point to second lateral edge with leading edge of blade and provide severance of ply stock from first lateral edge to second lateral edge.

In accordance with another aspect of the invention there is provided a knife assembly for use in a cutting apparatus for cutting an associated ply stock along a cut line of an anvil, knife assembly including a blade having a cutting portion including a leading point, a leading edge and a trailing edge, knife assembly characterized by:

a. leading edge of blade including a concave portion adjacent leading point for urging ply stock towards anvil; and,

b. trailing edge of blade having a generally linear profile.

According to a further aspect of the invention there is provided a cutting apparatus for cutting an associated ply stock along a cut line between first and second lateral edges, apparatus comprising a knife assembly, means for moving knife assembly toward and away from ply stock, and means for traversing knife assembly between first and second lateral edges of ply stock, knife assembly including a blade having a cutting portion including a leading point, a leading edge and a trailing edge, trailing edge having an associated length, cutting apparatus being characterized by:

knife assembly having a home position wherein leading point of blade is directly above an insertion point of associated ply stock and wherein a distance between first lateral edge of associated ply stock and insertion point is less than or equal to associated length of trailing edge.

One advantage of the present invention is that the ply stock can be cut between adjacent cords without severing either cord.

Another advantage of the present invention is that the ply stock can be severed without damaging either lateral edge of the ply stock.

Still other benefits and advantages of the invention will become apparent to those skilled in the art upon a reading and understanding of the following specification.

Brief Description of Drawings

The invention may take physical form in certain parts and arrangement of parts, a preferred embodiment of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

Figure 1 is a front view of one embodiment of the present invention with the knife blade inserted into the ply stock and showing the knife assembly at the end of the cutting stroke in phantom lines.

Figure 2 is an enlarged view of the knife blade shown in Figure 1 prior to insertion of the knife blade.

Figure 3 is a side view in section of the embodiment taken along the line 3-3 of Figure 1.

Figure 4 is a side view of the knife blade shown in Figure 2 taken along line 4-4.

Figure 5 is a partial view like Figure 2 showing the knife blade after insertion through the ply stock.

Figure 6 is a top view of the slotted anvil shown in Figure 1.

Figure 7 is a cross-sectional view of the anvil taken along line 7-7 in Figure 6.

Figure 8 is a cross-sectional view of the ply stock showing the knife blade inserted between a pair of embedded cords.

Figure 9 is an enlarged view of the knife blade showing the configuration of the cutting edges of the blade.

Detailed Description of the Invention

Referring now to the drawings wherein the showings are for purposes of illustrating a preferred embodiment of the invention only and not for purposes of limiting the same, Figure 1 shows an apparatus 10 for severing tire building sheet material, referred to herein as ply stock S.

The apparatus 10 includes a knife assembly 14 which is mounted to means for moving the knife assembly toward and away from the ply stock to be cut. The apparatus 10 further includes means for moving the knife assembly 14 across the ply stock from a first lateral edge 18 thereof to a second lateral edge 22. The apparatus 10 also includes an anvil 26 for supporting the ply stock S in the immediate area below a cut line A-A. The embodiment of apparatus 10 is shown in Figures 1, 2, and 3 for illustrative purposes only and not by means of limiting the invention. In the preferred embodiment, the apparatus 10 includes a frame 30, an anvil 26, a carrier 34 including guide bars 38 extending between end support members 42, and a carriage 46. The carrier 34 is mounted on the frame 30 for movement toward and away from the anvil 26. The carriage 46 is mounted slidably along the bars 38 of the carrier 34 to traverse the knife assembly 14 between end members 42. A suitable mechanism (not shown), such as a pneumatic cylinder, may be provided for moving the

carrier 34 toward and away from the anvil 26. Likewise, a suitable mechanism, such as a chain drive (not shown) may be provided for traversing the carriage 46 along guide bars 38. The ply stock S to be severed may be supported and moved in the direction shown by the arrow in Figure 3 by any suitable conveyor (not shown). Preferably, the conveyor advances the ply stock S by successive
 5 predetermined increments thereby providing uniform lengths of ply stock suitable for their intended application. The relative positioning of the members of apparatus 10 just before a cut is made is referred to herein as "home position" 48 and is illustrated in Figure 2. At home position 48, the knife assembly 14 is positioned above the first lateral edge 18 of ply stock S.

With reference to Figure 2, one embodiment of a knife assembly 14 according to the present
 10 invention is shown. The knife assembly 14 includes blade 50 having a cutting portion 54 including leading edge 58 and a trailing edge 62 which meet at leading point 66. Leading point 66 is used to penetrate the ply stock S upon downward movement of the knife assembly 14. In the preferred embodiment, the knife blade 50 is "hawk-billed" in shape with the leading edge 58 being curved in profile as shown in Figure 2, and the trailing edge 62 presenting a straight profile. As best shown
 15 in Figure 4, the cutting portion 54 of the blade 50 is tapered to effectively cut ply stock S. Both the leading edge 58 and the trailing edge 62 are tapered in the preferred embodiment.

As shown in Figure 5, the trailing edge 62 of the knife blade 50 has a length, L, measured in a direction parallel to the direction of the blade traverse from leading point 66 to trailing end 68 that is equal to or greater than distance D from insertion point 92 to first lateral edge 18 of the ply
 20 stock S.

The preferred embodiment of the cutting apparatus 10 further includes means such as electric resistance heaters 70 for heating the knife blade 50 before each successive cutting operation. As shown in Figure 1, in the preferred embodiment, the heaters 70 are secured to carrier 34 and do not traverse the ply stock S. The heaters 70 are positioned so that when the carriage 46 is positioned
 25 against left spacers 74 on the guide bars 38, the knife blade 50 is adjacent heaters 70 to enable the blade 50 to be heated before each successive cut. In the preferred embodiment, heater 70 is bifurcated to heat both sides of blade 50.

One embodiment of an anvil 26 for use with the present invention is shown in Figure 6 and Figure 7. The anvil 26 includes a sloping side 80 and support surface 84 having a slot 88 therein.
 30 During a cutting operation, the slot 88 is generally aligned with the cut line indicated by A-A in Figure 6.

The preferred method for cutting the ply stock S is set forth below. The ply stock S may include embedded cords 118. As shown in Figure 8, it is important that the ply stock S be cut between the adjacent cords 118 in a way that prevents exposing a bare cord or damaging either of

the adjacent cords. It is also important that the lateral edges of the ply stock S be protected from damage which can occur when the lateral edge of the ply stock is crushed when the ply stock is cut from the outer edge inwardly. In operation, the ply stock S is positioned beneath the knife assembly 14. The ply stock S is supported in an area immediately adjacent the cut line by the support surface 84 of anvil 26. The slot 88 in the support surface 84 is aligned with the path the knife blade 50 will travel. The ply stock S is held in the cutting position by use of holding means such as a holding assembly (not shown). The knife blade 50 is pre-heated. The knife assembly 14 is then moved downwardly toward the ply stock S to bring the leading point 66 of the knife blade 50 into contact with the ply stock S. The heated knife blade 50 softens the ply stock S so that the leading point 66 of the knife blade may be plunged through the ply stock S at an insertion point 92 and into the slot 88. The insertion point 92 is located near a first lateral edge 18 of the ply stock S. On the downward stroke, as the knife blade 50 enters the ply stock S, the trailing edge 62 of the blade back-cuts the ply stock from the insertion point 92 to the first edge 18. The knife assembly 14 is then moved across the remaining width of the ply stock, while the leading edge 66 of the knife blade 50 severs the ply stock. The knife blade 50 cooperates with the slotted anvil 26 to perform the severing operation. Minor adjustments in the cord positioning during the cutting process is done by the action of the blade 50 within the slot 88 in order to prevent split cords. After the second lateral edge 22 is traversed, the knife assembly 14 is lifted away from the ply stock S. The cut length is then moved away from the anvil 26 in preparation for a successive cutting operation. The knife assembly 14 is returned to a "home" position 48 as shown in Figure 3 where the blade 50 is heated again before beginning the next cut.

The preferred embodiment of the blade 50 is shown in Figure 9. There are several aspects of the preferred blade design which provide advantages over blades known in the art. For example, as the knife blade 50 is plunged into the ply stock S, the leading point 66 prevents movement of the blade 50 away from the lateral edge. The trailing edge 62 of the blade makes an angle α with the plane S-S of the ply stock S in order to back cut the ply stock from the insertion point to the first lateral edge. In the preferred embodiment, α is 30 degrees but may be in the range from 20 degrees to 40 degrees. The knife blade 50 is further characterized by the leading edge 58 having both a concave portion 120 and a convex portion 122 that meet at inflection point 124. The leading edge 58 makes an angle β with the plane S-S at the point of insertion which is preferably 90 degrees but may be from 70° to 90°. The leading edge 58 makes an angle θ with the plane S-S at a position X spaced from the plane of the ply stock S-S as shown in Fig. 9 a distance greater than the thickness of the ply stock so that as the knife assembly traverses the remaining width of the ply stock S, the

curvature of the leading edge 58 acts to cut the ply stock S and urge the ply stock S toward the anvil 26. Preferably the angle θ is 60 degrees but may be in the range of 40 degrees to 70 degrees.

The preferred embodiments of the invention have been described, hereinabove. It will be apparent to those skilled in the art that the above method and apparatus may incorporate changes and modifications without departing from the general scope of this invention. It is intended to include all such modifications and alterations in so far as they come within the scope of the appended claims or the equivalents thereof.

Having thus described the invention, it is now claimed: